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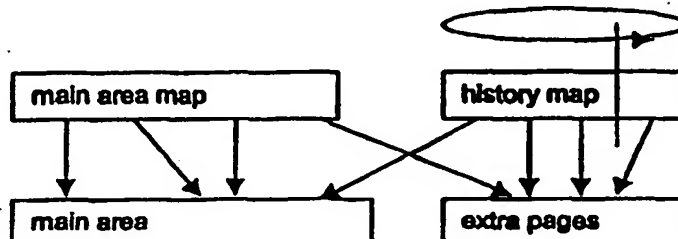
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>G06F 11/14</b>		<b>A3</b>	(11) International Publication Number: <b>WO 99/12101</b>
			(43) International Publication Date: <b>11 March 1999 (11.03.99)</b>
(21) International Application Number: <b>PCT/US98/18863</b>		<b>MN 55447 (US). SCHWARTZ, Lawrence, E. [US/US]; 1635 108th Lane, N.W., Coon Rapids, MN 55433 (US). BRUGGEMAN, Edward, W. [US/US]; 2771 Autumn Woods Drive, Chaska, MN 55318 (US).</b>  <b>(74) Agent: VIKSNINS, Ann, S.; Schwegman, Lundberg, Woessner &amp; Kluth, P.O. Box 2938, Minneapolis, MN 55402 (US).</b>  <b>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</b>	
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08/924,198      5 September 1997 (05.09.97)      US 09/039,650      16 March 1998 (16.03.98)      US 09/105,733      26 June 1998 (26.06.98)      US			
(63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Applications US      08/924,198 (CIP) Filed on      5 September 1997 (05.09.97) US      09/039,650 (CIP) Filed on      16 March 1998 (16.03.98) US      09/105,733 (CIP) Filed on      26 June 1998 (26.06.98)			
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(54) Title: METHOD, SOFTWARE AND APPARATUS FOR SAVING, USING AND RECOVERING DATA

## (57) Abstract

A method and apparatus for reverting a disk drive to an earlier point in time is disclosed. Changes made to the drive are saved in a circular history buffer which includes the old data, the time it was replaced by new data, and the original location of the data. The circular history buffer may also be implemented by saving new data elements into new locations and leaving the old data elements in their original locations. References to the new



data elements are mapped to the new location. The disk drive is reverted to an earlier point in time by replacing the new data element with the original data elements retrieved from the history buffer, or in the case of the other embodiment, reads to the disk are mapped to the old data elements still stored in their original locations. The method and apparatus may be implemented as part of an operating system, or as a separate program, or in the controller for the disk drive. The method and apparatus are applicable to other forms of data storage as well. Also disclosed are method and apparatus for providing firewall protection to data in a data storage medium of a computer system.

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# INTERNATIONAL SEARCH REPORT

International Application No

PC., JS 98/18863

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G06F11/14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 325 519 A (LONG DONALD W ET AL) 28 June 1994 cited in the application	1-10,12, 15,50, 51,59, 67,79
Y	see column 4, line 21 - column 10, line 9; figures 1-8	52,56, 57,60, 68,80, 85,86, 122,125, 139
A	---	18-20, 34,35, 93,127
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"S" document member of the same patent family

Date of the actual completion of the international search

12 February 1999

Date of mailing of the international search report

25.06.1999

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## INTERNATIONAL SEARCH REPORT

International Application No

PL, US 98/18863

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	ROBINSON J T: "ANALYSIS OF STEADY-STATE SEGMENT STORAGE UTILIZATIONS IN A LOG-STRUCTURED FILE SYSTEM WITH LEAST-UTILIZED SEGMENT CHEANING" OPERATING SYSTEMS REVIEW (SIGOPS), vol. 30, no. 4, October 1996, pages 29-32, XP000639698 see page 29, left-hand column, line 16 - line 22	52,56, 57,60, 68,80, 85,86
Y	--- US 5 339 406 A (CARNEY MICHAEL W ET AL) 16 August 1994 see abstract	122,125, 139
A	--- EP 0 751 462 A (TOKYO SHIBAURA ELECTRIC CO) 2 January 1997  see the whole document	52,60, 67,68, 79,80, 85,86, 127
A	--- GREEN R J ET AL: "Designing a fast, on-line backup system for a log-structured file system" DIGITAL TECHNICAL JOURNAL, vol. 8, no. 2, 1996, pages 32-45, XP002088807 see page 32, right-hand column, line 1 - page 35, left-hand column, paragraph 1 see page 36, paragraph 2 - page 40, paragraph 3	1-127, 139
A	--- WO 96 12232 A (VINCA CORP ;OHRAN RICHARD S (US); OHRAN MICHAEL R (US)) 25 April 1996 see abstract see page 7, line 1 - page 13, line 11	1-127, 139
A	--- US 5 089 958 A (HORTON JAMES A ET AL) 18 February 1992 see abstract	1-127, 139
A	--- WO 91 01026 A (INTELLIGENCE QUOTIENT INT) 24 January 1991 see abstract	1-127, 139
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# INTERNATIONAL SEARCH REPORT

International Application No

P. /US 98/18863

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>HULTGREN C D: "FAULT-TOLERANT PERSONAL COMPUTERS SAFEGUARD CRITICAL APPLICATIONS FAIL-SOFT PCS PROTECT CRITICAL DATA WITH INTERNAL MONITORING AND CONTROL, ULTRA-RELIABLE COMPONENTS, AND ENHANCED OPERATING SOFTWARE"</p> <p>I &amp; CS - INDUSTRIAL AND PROCESS CONTROL MAGAZINE,</p> <p>vol. 65, no. 9, 1 September 1992, pages 23-28, XP000316168</p> <p>see page 27, left-hand column, paragraph 6</p> <p>- page 28, right-hand column, paragraph 1</p> <p>-----</p>	<p>1-127, 139</p>

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 98/18863

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-127, 139

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-127,139

Disk based data backup and recovery in computer systems. Changes made to a disk drive are saved in a circular history buffer. The disk drive is reverted to an earlier point in time by 1. replacing new data elements with original data elements retrieved from the history buffer or 2. re-mapping of disk reads to old data still stored in their original locations on the disk.

2. Claims: 128-136

Method of protecting computer resources against unauthorised modification by verifying that program code executed by the processor of the computer is trusted code.

3. Claims: 137-138

A driver program within a storage controller for interfacing to a main processing unit. The driver program uses RAM and other resources separate from the main processing unit.

The International Searching Authority considers that the present application contains three inventions, not linked by a single general inventive concept (Rule 13.1 PCT). This observation is based on the following reasons:

a. The prior art has been defined as D1=US-A-5325519.

a.1 D1 discloses a method in a computer system for storing data on a storage device whereby the device includes processing circuitry for detecting access requests to alter data in respective locations of a storage device, and, prior to executing such requests, storing the data in an audit partition (circular buffer) of the storage device. The device can subsequently restore the data retained in the audit partition region to its previous location on the device and thereby return the storage device to a previous state (revert the computer system back in time).

b. Consequently, the special technical features identified by comparison with this prior art, as defined in Rule 13.2 PCT, are the following:

b.1 for invention nr. 1 (claims 1-127,139):

Merging the non-overwritten portion of the original data on the storage device with the portion of the original data recorded in the buffer to form a virtual (simulated) storage device (combining current and old data).

b.1.1 from this special technical feature the objective problem to be solved by the first invention can be seen in how to allow access to the state of a disk from an earlier time.

b.2 for invention nr. 2 (claims 128-136):

Protecting computer resources by verifying that program code executed by the processor of the computer is trusted code.

b.2.1 from this special technical feature the objective problem to be solved by the second invention can be seen in how to avoid the unauthorised modification of computer resources.

b.3 for invention nr. 3 (claims 137,138):

A driver program, within a storage controller, using RAM and other resources separate from a main processing unit.

b.3.1 from this special technical feature the objective problem to be solved by the third invention can be seen in how to prevent a malicious program (virus) of corrupting the internal data structure of a driver program for a storage controller.

c. The above analysis shows that the special technical features of invention 1 are not the same or similar to those characterising the other three inventions. Furthermore, a comparison of the objective problem 1 with each one of the objective problems 2 and 3, all seen in the light of the description and the drawings of the present application, indicates that these objective problems are all different and have no corresponding technical effects with regard to the first one. As a result, no correspondence (as defined in Rule 13.2 PCT, 2nd sentence) is present between the special technical features of invention 1 and those characterising the other two inventions.

c.1 The special technical features of inventions 2 and 3 are also not the same and, since they all solve different problems and have no corresponding technical effects; they are also not corresponding.

d. Thus, the application does not comply with the requirement of Unity of Invention (Rule 13 PCT).



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PL US 98/18863

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